MODERN TECHNOLOGIES USED IN DATA UPDATING FOR A SCHOOL FARM MODERNIZATION

MIHAI DORU.; MUDURA RADU.; TEODORESCU RAZVAN & ILINCA LIVIU

Abstract: The present paper is presenting how we can use a drone capability of tacking pictures in order to update the different information about a school farm, in order to create simulated scenarios of improving the specific activity. All data will be gathered and processed in GIS software, in the end, resulting different possible changes regarding the technical buildings, access network, irrigation schemes, crops planning and so on. Old data is represented by classic topographic survey and maps realized more than 10 years ago. The new data will be the images taken with a drone, GPS measurements, and terrestrial laser scanning and photos.

Key words: GIS, drone, aerial photo, laser scanning, survey

Authors´ data: Univ.Prof. Dipl.-Ing. Dr.techn. Mihai, D[oru]*; Dr. Sc. Mudura, R[adu]*; Univ.Prof. Dipl.-Ing. Dr.techn. Teodorescu, R[azvan]*; Dipl.-Ing. Dr.techn. Ilinca, L[iviui]**; *UASVM-Faculty of Land Reclamation and Environmental Engineering, Marasti Bd., 59, 1 district, Bucharest, Romania, ** S.C. SysCAD Solutions S.R.L., Strada Flori de Tei nr. 42, Sat Olteni, Comuna Clinceni, Jud. Ilfov, 077060, Romania, doru.mihai1@gmail.com, radu.mudura@gmail.com, razvan.iteodorescu@gmail.com, ilincalc@gmail.com

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1. Introduction

The Bucharest University of Agronomic Sciences and Veterinary Medicine has a Farm School at about 15 km North-East from the city. The Farm includes a Vegetal Farm (455 ha), a Fruit Farm (56 ha orchard), a Fish Farm (19 ha fish pond), a stable for pleasure horses, a cold storage with temperature and humidity controlled for fruit and vegetables storage (900 t), a modern farm for anseriformes (gooses and ducks) gene bank, an old mansion were Lev Nikolaevici Tolstoi (Russian writer) once lived and a lot of other facilities for students and researchers accommodation and training.

Along the time there were a lot of changes in the farm structure and in the last years the topographic maps and technical schemes were not updated. In this situation we proposed to use modern technology (GPS measurements, images taken with a drone, terrestrial laser scanning) in order to update the topographic and thematic maps of the farm.

New technologies available on the market are very suitable to our goal. It is well known that photogrammetric images are very good for maps updating. Updating maps based on such images are faster and cost less than a classical topographic survey. Nowadays in Romania it is rather difficult to schedule a classical photogrammetric flight and the costs are rather high. In this situation we decided to use images taken by a drone (UAV - Unmanned Aerial Vehicle). In more and more countries from Europe, Asia, North and South America, Australia and even Africa, drones are used, besides other applications, in topographic activities. Now drones designated to fit different civil domains like: Land Management, Commercial, Earth Science and Homeland Security, and are suitable for many applications such as: remote sensing and photogrammetry, surveying & mapping of earthquakes, surveying & mapping of plane crashes, surveying & mapping of storms and hurricanes, tidal mapping, mapping of industrial zones, mapping of excavation sites, surveying & mapping of flooding, surveying & mapping of train crashes, photogrammetry, mapping of the spread of algae, forestry surveying, mapping of vegetation, precision agriculture,
surveying & mapping of landslides, surveying & mapping of tsunamis, agriculture - GIS applications and mapping plant growth, geophysical mapping and so on.

The flight approvals took less than 15 days and the only impediment was the weather. We needed a sunny day and with no wind or a slow wind. During summer time in Romania are only a few rainy and windy days, so it was no problem to schedule the flight. In a couple of hours we covered the 445 ha of the farm and in the next two or three days we obtained the mosaic of images ready to be used for maps update.

2. Methodology

Instead of using standard topographic survey, in order to measure and determine the changes in the field we chose to use images taken by a drone. We chose the eBee mini drone.

![The eBee mini drone](image)

Fig. 2. The eBee mini drone

Here are the main characteristics of the system:

- 96cm wingspan;
- Less than 700g (1.5lbs) take-off weight;
- Lithium polymer battery powered;
- 45 minutes of flight;
- 36-57km/h (10-16m/s) cruise speed;
- Up to 45km/h (12m/s) wind resistance;
- Ground sensor and reverse enginetechology for linear landing;
- Up to 3km radio link;
- 16MP camera, electronically;
- Integratedand controlled;
- On-board data logging;
- Covers areas up to 10km2;
- Down to 3cm Orthomosaic accuracy;
• Down to 5cm Digital Elevation Model (DEM) accuracy;
• 3D flight planning and visualization;
• Flight simulator;
• Real time mission update and control;
• Multiple drones operation capable (with mid-air collision avoidance);
• Easy data management system (geotag images, create kml files and memorize flight history).

Fig. 3. Project MoaraDomnesca

Project history:

• Project: MoaraDomneasca;
• Processed: 2014-Jul-23 12:47:44;
• Camera name: CanonPowerShotELPH110HS_4.3_4608x3456;
• Average Ground Sampling Distance (GSD): 3.11 cm;
• Area covered: 0.9842 km\(^2\) / 98.4203 ha / 0.3802 sq. mi.;
• Image coordinate system: WGS84;
• Ground Control Point (GCP) coordinate system: DealulPiscului 1970 / Stereo 70 (deprecated);
• Output coordinate system: DealulPiscului 1970 / Stereo 70 (deprecated);
• Processing type: full (scale 1) aerial nadir;
• Time for initial processing (without report): 01h:51m:09s.

Quality check:

• Images: median of 53045 key points per image;
• Dataset: 360 out of 364 images calibrated (98%), all images enabled;
• Camera optimization quality: 0.11% relative difference between initial and final focal length;
• Matching quality: median of 6577.67 matches per calibrated image;
• Georeferencing: 5 GCPs (5 3D), 0.003 m.

Number of overlapping images computed for each pixel of the orthomosaic. Red and yellow areas indicate low overlap for which poor results may be generated. Green areas indicate an overlap over 5 images for every pixel. Good quality results will be generated as long as the number of key point matches is also sufficient for these areas (see Fig. 4 for key point matches).

![Figure 4](image1.png)

**Fig. 4.** Overlapping scheme of the images taken with eBee

Top view of the geotags with a link between matching images. The darkness of the links indicates the number of matched 2D key points between the images. Bright links indicate weak links and require manual tie points or more images.

![Figure 5](image2.png)

**Fig. 5.** The geotags with a link between matching images
After processing the images taken by the drone with the Postflight Terra 3D software, we obtained the new image mosaic. On this new image we could see the new constructions built up in the last years and who are not on the initial maps. Some of the old buildings were demolished in order to build the new one. Also we could see very clear different changes in the agricultural field structure. Different parcels were divided, other merged. Due to that several field roads were modified. In the future many other modifications are already planned. Using the GIS technology it will be much easier to make different scenarios according to nowadays needs.

Some of the element missing from the ancient maps was determined in the field by GPS measurements or terrestrial laser scanning. We have used laser scanning technology in order to acquire the high pressure tanks from the irrigation installation. In Fig. 8. You can see the point cloud representing the irrigation high pressure tanks that were scanned with Leica Scan Station 2. After scanning the point cloud was processed with Cyclone 6.01 software.
Fig. 7. The new “star” building with accommodation facilities for students and researchers
Fig. 8. Point cloud with the irrigation high pressure tanks

For a more accurate verification of the images taken with the eBee drone we performed a series of GPS point determination that were compared with the resulting image. In Fig. 8, you can see a test parcel that was measured on the ground with GPS equipment. All the 35 control points matched with the image.

Fig. 8. Control points determined by GPS
In the end all data was gathered in a GIS project and we were able to produce new maps with the actual situation of the assets of the Moara Domneasca School Farm.

Fig. 9. GIS project with new vectors based on the images taken with the drone

3. Conclusion

In conclusion we recommend the use of UAV / Drone equipment in order to perform information updating. The eBee drone can be equipped with different camera sensors, RGB, thermal, infra-red. This gives the opportunity to capture images that can be used also for vegetation monitoring, moisture level, etc.

Our goal was to update in a very short time the maps regarding the school farm and we succeeded in less of two weeks. Now, having access to that mini drone, we plan to make several new surveys next year, for crop monitoring, irrigation and moisture monitoring. All data will be managed in GIS and classical operations will be made easier using this new technology. For Romania they are still new technologies compare to Western Europe and United States of America, and we try to adapt them to our conditions.

It is true that the entire mission depended on the weather condition. In the areas with strong wind the drone will not be able to produce stable pictures on which you can rely on. A good weather with no precipitations, no fog and no wind is preferred.
With less equipment and with only one day in the field we succeeded to gather enough information to update the maps and to build a GIS for the Moara Domneasca Farm School.

For small areas (less 1000 ha) we recommend to use pictures taken by the drone (UAV). The image processing time is short and the resulting image is not very big and it is easy to process in different software applications.

4. Acknowledgements

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5. References


